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Docket No.: 04242/0203345-US0
(PATENT)**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent Application of:
Stephen J. Kennedy

Application No.: Not Yet Assigned

Confirmation No.: N/A

Filed: Concurrently Herewith

Art Unit: N/A

For: IMPROVED STRUCTURAL SANDWICH
PLATE MEMBERS

Examiner: Not Yet Assigned

AFFIRMATION OF CLAIM FOR PRIORITYCommissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Applicant hereby claims priority under 35 U.S.C. 119 based on the following prior foreign application filed in the following foreign country on the date indicated:

<u>Country</u>	<u>Application No.</u>	<u>Date</u>
United Kingdom	0306195.9	March 18, 2003

In support of this claim, a certified copy of the aforesaid Patent Application was received by the International Bureau on March 30, 2004 during the pendency of International Application No. PCT/GB2004/001003. A copy of Form PCT/IB/304 is enclosed.

Dated: September 13, 2005

Respectfully submitted,

By 

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REC'D 30 MAR 2004

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19MAR03 1793237-5 000192
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The Patent Office

Cardiff Road
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1. Your reference

N.86161 JGL

2. Patent application number

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0306195.9

18 MAR 2003

3. Full name, address and postcode of the or of each applicant (underline all surnames)

INTELLIGENT ENGINEERING (BAHAMAS) LIMITED
Bahamas International Trust Building
Bank Lane
PO Box N8188

Patents ADP number (if you know it)

777 5000001

If the applicant is a corporate body, give the country/state of its incorporation

Bahamas

4. Title of the invention

IMPROVED STRUCTURAL SANDWICH PLATE MEMBERS

5. Name of your agent (if you have one)

J.A. KEMP & CO.

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

14 South Square
Gray's Inn
London
WC1R 5JJ

Patents ADP number (if you know it)

26001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
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Yes

a) any applicant named in part 3 is not an inventor, or
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c) any named applicant is a corporate body.
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Description 7

Claim(s) 2

Abstract 1

Drawing(s) 1

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Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77) 1

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date 18 March 2003

J.A. KEMP & CO.

12. Name and daytime telephone number of person to contact in the United Kingdom

LEEMING, John Gerard
020 7405 3292

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IMPROVED STRUCTURAL SANDWICH PLATE MEMBERS

The present invention relates to structural sandwich plate members which
5 comprise two outer plates and a core of plastics or polymer material bonded to the
outer plates with sufficient strength to substantially contribute to the structural
strength of the member.

Structural sandwich plate members are described in US 5,778,813 and US
6,050,208, which documents are hereby incorporated by reference, and comprise
10 outer metal, e.g. steel, plates bonded together with an intermediate elastomer core,
e.g. of unfoamed polyurethane. These sandwich plate systems may be used in
many forms of construction to replace stiffened steel plates and greatly simplify
the resultant structures, improving strength and structural performance (stiffness,
damping characteristics) while saving weight. Further developments of these
15 structural sandwich plate members are described in WO 01/32414, also
incorporated hereby by reference. As described therein, foam forms may be
incorporated in the core layer to reduce weight and transverse metal sheer plates
may be added to improve stiffness.

According to the teachings of WO 01/32414 the foam forms can be either
20 hollow or solid. Hollow forms generate a greater weight reduction and are
therefore advantageous. The forms described in that document are not confined to
being made of light weight foam material and can also be made of other materials
such as wood or steel boxes.

~~International Patent Application WO-02/078948 is a further development~~
25 of the concept of including hollow forms and describes forms that are easy to
manufacture and assemble, in particular hollow elongate forms made from snap-
together pieces are described.

The basic forms of structural sandwich plate members described in US
5,778,813 and US 6,050,208 have excellent fire resistance properties, such plate
30 members of dimensions suitable for ship building purposes easily pass

International Maritime Organisation (IMO) Safety of Life at Sea (SOLAS) A-60 fire tests, even without additional insulation. However, plate members such as those described in WO 01/32414 and WO 02/078948 do not pass these tests without additional insulation on the side exposed to the fire. Without such

5 insulation the temperature of the unexposed side rapidly rises.

It is an aim of the present invention to provide structural sandwich plate members including lightweight forms within the core that have improved fire resistance and preferably can meet prescribed fire resistance test.

According to the present invention, there is provided: a structural

10 sandwich plate member comprising: first and second outer plates; a core of plastics or polymer material bonded to said outer plates with sufficient strength to transfer shear forces therebetween; and a plurality of relatively lightweight forms disposed within said core; wherein said lightweight forms are made of a fire-resistant insulating material.

15 The present inventors have determined that prior art structural sandwich plate members with lightweight forms made of foam fail fire tests because the foam melts quickly leaving relatively large voids extending between the faceplates of the panel. Where the lightweight form is hollow, the voids exist from the outset. The air and other gasses in those voids can then conduct heat to the panel on the side

20 away from the fire. By making the lightweight forms out of a fire resistant material, such as mineral wool, this is avoided. The form does not melt and so there is no large open void across which heat can be conducted.

Preferably the lightweight form should be made of a material having an ignition point and a melting point higher than 1000°C.

25 In a preferred embodiment of the invention, the lightweight foam comprises fire resistant material encased in a barrier impermeable to the liquid form of said plastics or polymer material.

With this arrangement, the plate member can be made by injection molding after placement of the lightweight forms in a cavity made by the two

30 outer plates, as described in WO 01/32414 and WO 02/078948. The barrier

prevents the liquid plastics or polymer material soaking into the insulating material. For example, the lightweight forms may comprise a preformed type of solid plastic, foam, metal or other material into which the insulated material is placed. In that case, the pipe may be constructed as in any of the embodiments
5 described in WO 02/078948. Alternatively, the insulating material may be shaped to the required geometry and sprayed or dipped in a coating material which hardens to provide the outer layer. A further alternative is to wrap the insulating material in a thin outer layer such as metal foil, felt or mineral cloth.

The insulating material is preferably mineral wool and may have a density
10 in the range of from 30 kg/m³ to 200 kg/m³.

It should be noted that the lightweight forms serve to reduce the mass of the structural sandwich plate member and need not contribute significantly to its structural strength. The principal requirements on the lightweight forms are that they are of lower density than the plastics or polymer material forming the core
15 and have sufficient thermal and mechanical properties to maintain the desired shape during injection and curing of the plastics or polymer core. The layout of the forms within the core may be as described in British patent application 0 212 392.5 filed 29 May 2002.

The materials, dimensions and general properties of the outer plates of the
20 structural sandwich plate member of the invention may be chosen as desired for the particular use to which the structural sandwich plate member is to be put and in general may be as described in US-5,778,813 and US-6,050,208. Steel or stainless steel is commonly used in thicknesses of 0.5 to 20mm and aluminium may be used
~~where light weight is desirable. Similarly, the plastics or polymer core may be any~~
25 suitable material, for example an elastomer such as polyurethane, as described in US-5,778,813 and US-6,050,208.

Further, the invention provides a method of manufacturing a structural sandwich plate member comprising the steps of: providing first and second outer plates in a spaced-apart relationship with a plurality of lightweight forms located
30 therebetween; injecting uncured plastics or polymer material to fill the space

defined between said outer plates and said lightweight forms; and allowing said plastics or polymer material to cure to bond said outer plates together with sufficient strength to transfer shear forces therebetween; wherein said lightweight forms are made of a fire resistant insulating material.

5 The present invention will be described below with reference to exemplary embodiments and the accompanying schematic drawings, in which:

Figure 1 is a plan cross-sectional view of a structural sandwich plate member according to a first embodiment of the present invention;

Figure 2 is a cross-sectional view of a structural sandwich plate member
10 according to a second embodiment of the present invention; and

Figure 3 is a cross-sectional view of a structural sandwich plate member according to a third embodiment of the present invention.

In the various drawings, like parts are indicated by like reference numerals.

15 The structural sandwich plate member shown in Figure 1 comprises upper and lower outer plates (faceplates) 11, 12 which may be of steel and have a thickness of e.g. in the range of from 0.5 to 20mm. Edge plates are welded between the faceplates 11, 12 around their outer peripheries to form a closed cavity. In the cavity between the faceplates 11, 12 is a core 13 of plastics or polymer material,
20 preferably a polyurethane elastomer. This core may have a thickness in the range of from 15 to 200mm; in the present application 160mm is suitable. The core 13 is bonded to the faceplates 11, 12 with sufficient strength and has sufficient mechanical properties to transfer shear forces expected in use between the two faceplates. The bond strength between the core 13 and faceplates 11, 12 should be

25 greater than 3MPa, preferably 6MPa, and the modulus of elasticity of the core material should be greater than 250MPa. For low load applications, such as floor panels, where the typical use and occupancy loads are of the order of 1.4kPa to 7.2kPa, the bond strength may be lower, e.g. approximately 1MPa. By virtue of the core layer, the structural sandwich plate member has a strength and load
30 bearing capacity of a stiffened steel plate having a substantially greater plate

thickness and significant additional stiffening.

To reduce the weight of the structural sandwich plate member 10, not all of the volume between the faceplates 11, 12 is occupied by core 13. Instead, an array of lightweight forms 14 is provided, occupying a substantial part of the internal
5 volume of the plate member. The lightweight forms 14 do not need to significantly contribute to the structural strength of the plate and they require only to have thermal and mechanical properties sufficient to withstand the pressure of injection of the material to form core 13, the heat from the exothermic reaction of the core during curing and temperatures experienced during fires.

10 The forms 14 comprise a hollow pipe 15 filled with fire resistant insulating material 16. The pipe 15 serves to prevent the liquid core material during injection molding of the core from soaking into the insulating material which ensures that there is no large void extending through the core material even during fire conditions reducing heat conduction between the faceplates 11, 12. The pipe 15,
15 although illustrated as circular in section, may take many other forms, including rectangular, hexagonal, or octagonal sections and may have ribs internally to provide additional strength or externally to space the form away from other forms, the edge plates, or the faceplates. In general, the pipe may take any of the forms described in International patent application GB 02/01565. The insulating
20 material is preferably mineral wool, for example as supplied by Rockwool Limited of Pencoed, Bridgend CF35 6NY, UK. The insulating material may have a density in the range of from 30 kg/m³ to 200 kg/m³ and preferably has an ignition point and melting point higher than 1000°C, preferably.

~~To manufacture the structural sandwich plate member 10, the edge plates~~
25 are welded around the periphery of lower faceplate 11 and then forms 14 and any spacers placed in the resulting open cavity. At this stage, any precast sections of the core may be put in place as well as any shear plates or other fittings that may be desired. Then, the upper faceplate 12 is welded to the edge plates to form a closed cavity and the plastics or polymer material injected to form core 13. The
30 injected material is then allowed to cure and the injection ports used in the

injection step ground off and sealed along with the vent holes. These steps may be performed in situ, or off-site in factory conditions and the finished panel transported to the installation site.

A second embodiment of the present invention is shown in Figure 2. The structural sandwich plate member 20 according to the second embodiment of the invention is similar to the first embodiment but different in the construction of the lightweight forms, as described below.

In the second embodiment, the lightweight forms 24 comprise blocks 26 of insulating material which are formed in the desired shape. As illustrated, the blocks are square in section but may be rectangular, hexagonal, octagonal or other shapes in section and may have a uniform section or vary in cross-section along their lengths. To prevent the liquid core material soaking into the insulating material during injection, the blocks 26 of fire resistant insulating material are sprayed with or dipped in a coating material which hardens to provide an impervious outer layer.

Figure 3 illustrates a third embodiment of the present invention which differs from the second embodiment in the manner of formation of the barrier around the insulating materials. In the third embodiment, the blocks 36 of fire resistant insulating material are wrapped in a sheet material 35, rather than being coated. The sheet material 36 may, for example, comprise metal foil, felt, mineral cloth or suitable plastics or polymer sheet.

It will be appreciated that the above description is not intended to be limiting and that other modifications and variations fall within the scope of the present invention, which is defined by the appended claims. For example, if the core of the structural sandwich plate member is formed by precast elastomer blocks, the barrier enclosing the fire resistant insulating material may be omitted. Also, where the lightweight forms extend between the faceplates of the structural sandwich plate member it may suffice to provide a barrier only on the sides of the

lightweight forms which will come into contact with the core material rather than fully encasing the forms. A separate barrier may also be omitted if the insulating material, or at least a surface region of the form, is sufficiently dense that ingress of liquid core material during molding is limited.

CLAIMS

1. A structural sandwich plate member comprising:
5 first and second outer plates;
a core of plastics or polymer material bonded to said outer plates with
sufficient strength to transfer shear forces therebetween; and
a plurality of relatively lightweight forms disposed within said core;
wherein said lightweight forms are made of a fire resistant insulating
10 material.
2. A structural sandwich plate member according to claim 1 wherein each of
said lightweight forms comprises a barrier impermeable to the liquid form of said
plastics or polymer material between said fire resistant insulating material and said
15 core.
3. A structural sandwich plate member according to claim 2 wherein said
barrier comprises an elongate hollow tube which is filled with said fire resistant
insulating material
20
4. A structural sandwich plate member according to claim 2 wherein said
barrier comprises a coating which has been applied to blocks of said fire resistant
insulating material by spraying or dipping.
- 25 5. A structural sandwich plate member according to claim 2 wherein said
barrier comprises a sheet material wrapped around said fire resistant insulating
material.
6. A structural sandwich plate member according to claim 5 wherein said
30 sheet material is selected from the group comprising metal foil, felt, mineral cloth

and plastics or polymer sheet materials.

7. A structural sandwich plate member according to any one of the preceding claims wherein said fire resistant insulating material comprises mineral wool.

5

8. A structural sandwich plate member according to any one of the preceding claims wherein said fire resistant insulating material has a density in the range of from 30 kg/m³ to 200 kg/m³.

10 9. A structural sandwich plate member according to any one of the preceding claims wherein said fire resistant insulating material has an ignition point and a melting point each greater than 1000°C.

10. A method of manufacturing a structural sandwich plate member
15 comprising the steps of:
 providing first and second outer plates in a spaced-apart relationship with a plurality of lightweight forms located therebetween;
 injecting uncured plastics or polymer material to fill the space defined between said outer plates and said lightweight forms; and
20 allowing said plastics or polymer material to cure to bond said outer plates together with sufficient strength to transfer shear forces therebetween;
 wherein said lightweight forms are made of fire resistant insulating material.

25 11. A structural sandwich plate member constructed substantially as hereinbefore described with reference to the accompanying drawings.

12. A method of manufacturing a structural sandwich plate member substantially as hereinbefore described with reference to the accompanying
30 drawings.

ABSTRACT

IMPROVED STRUCTURAL SANDWICH PLATE MEMBERS

5

A structural sandwich plate member comprises first and second outer plates and a core of plastics or polymer material. A plurality of lightweight forms are disposed between the outer plates so that the core material forms ribs extending in two substantially orthogonal directions. The lightweight forms are formed of a
10 fire resistant insulating material, such as mineral wool, preferably surrounded by a barrier to prevent the insulating material being soaked by the liquid form of the plastics or polymer material during injection of the core. The barrier may take the form of a hollow tube in which the insulating material is placed or a coating applied by dipping or spraying or a sheet material such as metal foil, felt, mineral
15 cloth, etc..

Fig.1

Fig. 1

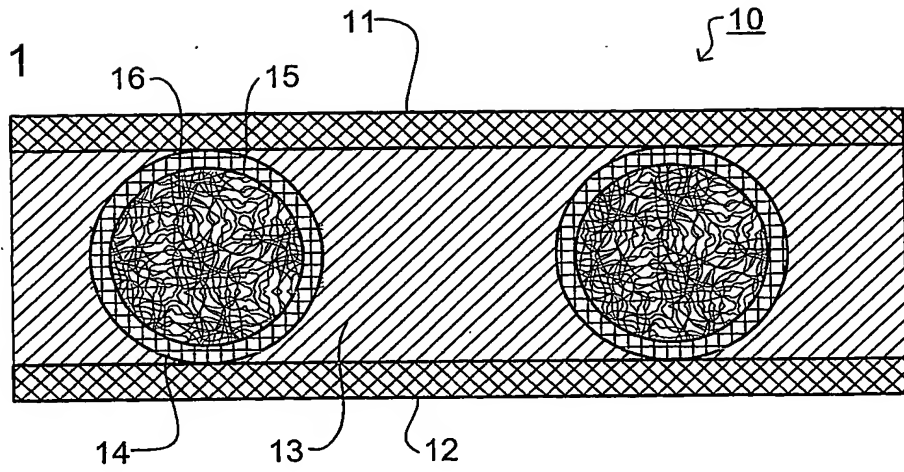


Fig. 2

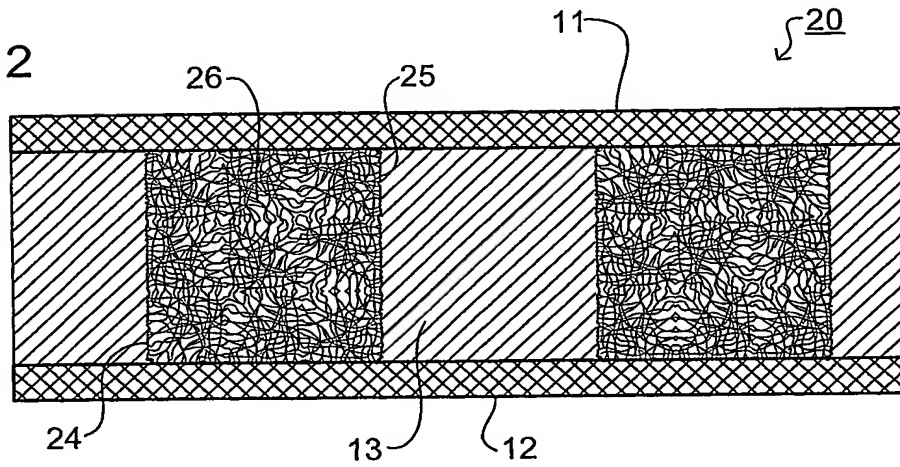


Fig. 3

